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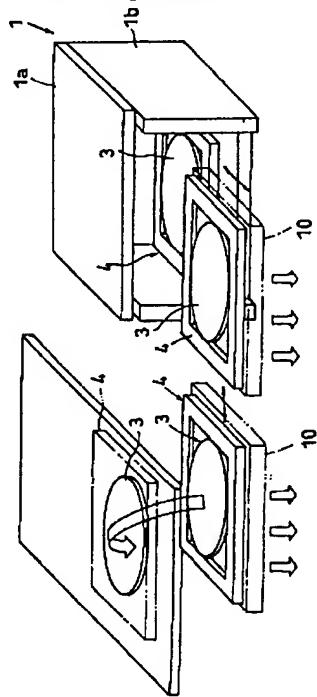
(54) [Title of invention] Taking out and transporting method for sheet shape inorganic material, and tray for storage and transportation

(57) [Summary]

[Objective] Providing taking out and transporting method for sheet shape inorganic material, and tray for storage and transportation to be conveniently used for that, which are able to securely conduct storing, taking out, and transporting to specific locations of the sheet shape inorganic material with simple methods.

[Method for solution] In taking out and transporting method for sheet shape inorganic material including a process to take out a sheet shape inorganic material 3 being stored in a container 1 and to transport the taken out sheet shape inorganic material 3 to a specific location; multiple quantity of said sheet shape inorganic materials 3 are stored in said container 1 in a condition of being mounted on trays 4 by using trays 4 of which at least mounting surface is formed with porous resin sheet, a sheet shape inorganic material 3 is taken out along with each tray 4 from the container 1, and taken out sheet shape inor-

ganic material 3 is transported to a specific location while being sucked from the back-side of said mounting surface.



**[Claims]**

**[Claim 1]** In taking out and transporting method for sheet shape inorganic material including a process to take out a sheet shape inorganic material being stored in a container and to transport the taken out sheet shape inorganic material to a specific location; taking out and transportation method for sheet shape inorganic material which is characterized that multiple quantity of said sheet shape inorganic materials are stored in said container in a condition of being mounted on trays by using trays of which at least mounting surface is formed with porous resin sheet, a sheet shape inorganic material is taken out along with each tray 4 from the container, and taken out sheet shape inorganic material is transported to a specific location while being sucked from the backside of said mounting surface.

**[Claim 2]** Taking out and transporting method for sheet shape inorganic material being described in Claim 1 wherein said tray is provided with holding wall which is able to hold side wall of the sheet shape inorganic material on at least a part of outer fringe of said mounting surface.

**[Claim 3]** Taking out and transporting method for sheet shape inorganic material being described in Claim 1 or 2 wherein said porous resin sheet is made of super high molecular weight polyethylene and thickness is 0.05 to 3 mm.

**[Claim 4]** Tray for storage and transporting for sheet shape inorganic material wherein mounting surface of the sheet shape inorganic material is formed with porous resin sheet for enabling suction from backside, and holding wall which is able to hold side wall of said sheet shape inorganic material is provided on at least a part of outer fringe of said mounting surface.

**[Detailed explanation of the invention]**

**[0001]**

**[Technical field that the invention belongs]**

This invention concerns taking out and transporting method for sheet shape inorganic

material for taking out sheet shape inorganic material which is easily broken because thickness is thin from a container and transporting to specific position, and tray for storage and transportation which is conveniently used for this.

**[0002]**

**[Prior technology]** It has been known that sheet shape inorganic materials such as glass substrates for the production of such as liquid crystal display panels, wafers for the production of semiconductor electronic parts and ceramic sheets for the production of circuit boards are extremely prone to break because thickness is thin relative to the area despite materials themselves are brittle. For example, there are silicon wafers in a size of 8 inches but their thickness is 0.2 to 0.5 mm, thus they are extremely prone to break.

**[0003]** Containers made of molded body of such as ABS resin are used for storage and transportation of these sheet shape inorganic materials, and it is common to store multiple sheets by inserting into multiple grooves for storage. Further, because there are problems such as that wafers and glass substrates break by impact during transportation, there have been those having cushion materials between (patent public notice of Patent Publication Number Hei 10-5081).

**[0004]**

**[Problems to be solved by the invention]**  
However, Accompanied with the enlargement of glass substrates and thinning of semiconductor wafers, improvement of storage and transportation container has been desired. It is because there are problems such as the breakage of substrate due to warping because holding with substrate itself is difficult. Further, although this problem is able to be solved with a method to insert cushion material between layers, there are drawbacks that storage quantity decreases due to the increase of total thickness or larger containers are required.

**[0005]** On the other hand, cushion material comprising porous resin sheet, which is sheet

shape cushion material that supports a semiconductor wafer on the sheet surface, for transporting semiconductor wafers, has been disclosed in public notice of Patent Publication Number Hei 8-330407. With this cushion material, it is able to prevent damages to semiconductor wafers by vibrations and impacts during transportation and prevent warping of wafers too, and is advantageous from the standpoint of space.

**[0006]** However, there have been a problem with these cushion materials that taking out and storage takes time such as that such as semiconductor wafers and cushion materials are separately taken out from a container when such as wafers in storage are taken out from a transportation container. Also, there has been a problem that transporting process is complicated such as that there is a need to separately transport with a method which hardly destroy the semiconductor wafer when transporting such as the semiconductor wafer being taken out to next process.

**[0007]** Therefore, the objective of this invention is to provide taking out and transporting method for sheet shape inorganic material, and tray for storage and transportation to be conveniently used for that which is able to securely conduct storing and taking out, and transportation to specific locations of the sheet shape inorganic material with simple processes.

**[0008]**

**[Means to solve the problem]** Above objective may be accomplished by this invention as described below. Which is that, in taking out and transporting method for sheet shape inorganic material which includes a process to take out sheet shape inorganic material being stored in a container and to transport the taken out sheet shape inorganic material to specific location; taking out and transporting method of this invention for sheet shape inorganic material is characterized that multiple quantity of said sheet shape inorganic materials are stored in said container by using trays of which at least mount-

ing surface is formed with porous resin sheet and in a condition that they are mounted on those trays, the sheet shape inorganic material is taken out from the container along with individual tray, and taken out sheet shape organic material is transported to specific location while being sucked from backside of said mounting surface.

**[0009]** In above described, said trays are desired to be those which are provided with a holding wall, which is able to hold side wall of sheet shape inorganic material, on at least a part of outer fringe of said mounting surface.

**[0010]** Further, that porous resin sheet is desired to be made of super high molecular weight polyethylene and thickness is 0.05 to 3 mm.

**[0011]** On the other hand, the storage and transporting tray for sheet shape inorganic material is characterized that mounting surface for the sheet shape inorganic material is formed with porous resin sheet for enabling suction from backside, and a holding wall, which is able to hold side wall of said sheet shape inorganic material, is provided on at least a part of outer fringe of said mounting surface.

**[0012]** **[Function and effect]** According to the taking out and transporting method of this invention, it is able to transport sheet shape inorganic material being taken out from the container while sucking from backside of the mounting surface, and able to conduct from storing to transporting while it is mounted on a tray, because it stores multiple quantity in a container by using trays of which at least mounting surface is formed with porous resin sheet. Therefore, a series of processes are simplified and also secure transporting is enabled by suction transportation. Further, a problem due to existence of dust and abrasion is less prone to occur because the sheet shape inorganic material and mounting surface of the tray are kept contacted.

**[0013]** When said trays are those which are provided with a holding wall, which is able to hold side wall of the sheet shape inorganic

material, on at least a part of outer fringe of said mounting surface, it is able to securely pull out a mounted sheet shape inorganic material when a tray is pulled out from a container, or on the other hand it is able to prevent the sheet shape inorganic material which is contacting with the backside of a tray from being pulled out by mistake.

[0014] When said porous resin sheet is made of super high molecular weight polyethylene and thickness is 0.05 to 3 mm, the porous resin sheet being made of super high molecular weight polyethylene is superior in abrasion resistance and chemical resistance, and is able to be made into trays being less in dust generation and excellent in durability.

Further, it becomes easier to realize such as appropriate strength, cushioning property and air permeability by making it in above described thickness.

[0015] On the other hand according to the tray for storage and transportation, it may be especially favorably used for the taking out and transporting method of this invention for sheet shape inorganic material which shows above described functional effect, because mounting surface is formed with porous resin sheet for enabling suction from backside and a holding wall is located on at least one part of outer fringe of the mounting surface.

[0016]

**[Form of embodiment of the invention]**

A form of embodiment of this invention is explained below by referring to illustrations. Figure 1 (a) is a cross sectional drawing showing an example of storing multiple sheet shape inorganic materials in a container by using trays of this invention, and Figure 1 (b) is a plan view drawing showing an example of mounting a sheet shape inorganic material on the tray.

[0017] The taking out and transporting method of this invention for sheet shape inorganic material includes a process to take out sheet shape inorganic material 3 being stored in a container 1 as shown in Figure 1 from the container 1, and transport the taken

out sheet shape inorganic material 3 to a specific location. As the sheet shape inorganic materials, such as glass substrate for making such as liquid crystal display panels, wafers for making semiconductor electronic parts, and ceramic sheets for making circuit boards.

[0018] This invention uses trays 4 wherein at least mounting surface 4b is formed with porous resin sheet. In this form of embodiment, trays 4 are shown as example wherein holding wall 4a which is able to hold side wall 3a of sheet shape inorganic material 3 is located on entire part of outer fringe of mounting surface 4b, as shown in Figure 1. In this invention, those which are not provided with the holding wall 4a or those which are located with a holding wall 4a on a part of outer fringe of the mounting surface 4b may be used. When locating the holding wall 4a on a part of outer fringe of the mounting surface 4b, it is desirable to locate it on far side of the tray 4 from the standpoint of securely pulling out the mounted sheet shape inorganic material 3 when pulling out a tray 4 from the container 1, and it is desirable to locate it on near side of the tray 4 for preventing a sheet shape inorganic material 3 which is contacting with backside of tray 4 from being mistakenly pulled.

[0019] There may be no gap between the side wall 3a of sheet shape inorganic material 3 and the holding wall 4a, however, it is desirable to be made at around 1 to 3 mm from the standpoint of conducting secure mounting.

[0020] Fringe section 4c for forming this type of holding wall 4a of tray 4 does not have to be formed with the porous resin sheet, however, entire tray 4 is desired to be integrally formed with the porous resin sheet from the standpoint of preventing contamination of the sheet shape inorganic material 3. Formed trays in these shapes is able to be formed by using metal mold in those shapes. Further, they may be formed by such as thermally fusing the fringe section 4c comprising porous resin or non-porous resin sheet to flat

porous resin sheet, from the standpoint of the cost.

[0021] Although the holding wall 4a is formed in square against circular sheet shape inorganic material 3, the holding wall may be formed in circular or other shapes. Further, although the holding wall 4a of tray 4 is continuously formed on outer fringe of the mounting surface 4b, it may be separated and multiple holding walls 4a may be formed with spaces between. Layout of these holding walls 4a may be appropriately determined according to the shape of sheet shape inorganic material 3. Height of the holding wall 4a may be made to be either shorter or taller than thickness of the sheet shape inorganic material, however, it is desired to be equal or less than the thickness of sheet shape inorganic material 3, from the standpoint of making deflection of the sheet shape inorganic materials 3 when many are stacked.

[0022] As forming material of the porous resin sheet in this invention, resins such as polyethylene, polypropylene and polystyrene, are mentioned, for example. It preferably is super high molecular weight polyethylene. Above described resin may be used alone or two or more kinds may be used together.

[0023] These porous resins may be produced by a method of sintering said resin powder by holding a heat press or a method of sintering said resin powder by filling into a metal mold. And the porous resin sheet is able to be obtained by forming thus obtained porous resin into sheet shape by such as cutting. This thickness is desirably 0.05 to 3 mm and more desirably it is 0.1 to 1.0 mm.

[0024] And use of porous resin sheet being made of super high molecular weight polyethylene which is described in public notice of Patent Publication Number Hei 5-66855 is desirable as the porous resin sheet to be used in this invention. Said super high molecular weight polyethylene has extremely high molecular weight of approximately 500,000 or more (measured value by viscosity method) compared to general polyethylene

which is approximately 100,000 in molecular weight. And said porous resin sheet being made of super high molecular weight polyethylene is in high quality taking a uniform porous structure and later described continuous pores are uniformly distributed.

[0025] The porous resin sheet being used in this invention is required to have low concentration of the content amount of alkaline metal ion and halogen compound ion which have negative effect to semiconductor because it directly contacts with such as semiconductor wafers, and in concrete, each of them is desired to be 10 ppm or less. Normally, most of those which are used for cushion materials are foamed body being foamed with such as forming agent. These formed body contains impurity and such as residual gasses are considered to be a problem especially for application for semiconductor, however, the porous sheet of this invention does not have those problems. This is due to the production method and because it is made to be porous without using foaming agent (public notice of Patent Publication Number Hei 7-55541).

[0026] Also, the porous resin sheet being used for this invention has excellent cushioning property compared to those of inorganic material, because of its porous structure, and absorbs or reduces impact and vibration during transportation. This porous structure is normally designated by pore rate and it is desirably 10 to 65 %, especially desirably 20 to 40 % from the standpoints of air permeability, cushioning property and strength.

[0027] The air permeability is effective within a range of 1 to 50  $\text{cm}^3/\text{cm}^2\cdot\text{sec}$ . and it is preferably 2 to 10  $\text{cm}^3/\text{cm}^2\cdot\text{sec}$ . Further, it is a characteristic too that it is able to work shape of container without ruining air permeability if porous resin sheet is used, and it is able to adjust to size of substrate to be stored and shape of storage case.

[0028] And the porous resin sheet being used in this invention is desired to be 10 % or more in surface opening ratio of it, and it is especially desirable to be 20 % or more. This is

because there is an advantage that contact area becomes less if surface opening ratio is at certain value or greater. Where, the surface opening ratio is able to be measured by observation by surface microscopy.

[0029] Further, the porous resin sheet being used in this invention is desired to be those which have pores that continue from one side of the sheet to the other side, and these continuous pores are able to be formed by producing porous resin with above described sintering method. These continuous pores may be through holes that linearly go through in the thickness direction of the sheet, or those of connection of air bubble like cavities in the sheet. By having these continuous pores, static electricity that is generated by rubbing on the sheet surface will be dissipated in sheet thickness direction and static charge of the porous resin sheet is suppressed. These continuous holes may exist on a part of the sheet, however it is desired to uniformly distributed in entire sheet.

[0030] The porous resin sheet to be used in this invention may be used as is, however it is desired to be treated for anti-static electricity according to its usage. As said anti-static electricity treatment, there is no specific restriction, however, a method to coat anti-static electricity agent for semiconductor is mentioned. As commercially sold this anti-static electricity agent for semiconductor, such as Rhesol\* Super TW-L120, Emasol Super L-10F (product names, both are made by Kao Co., Ltd.) and Eelctro-Stopper may be mentioned as examples. \*Translator's note: "Rhesol" must be a mistake of "Reodol" according to Kao's web page information. Further, when anti-static electricity agent is coated on the porous resin sheet of this invention, the anti-static electricity agent enters its pores and is sustained, thus the effect of anti-static electricity sustains for long time. Also, there is an advantage that migration of the anti-static electricity agents is less because contact area with semiconductor wafers is less compared to those

without pores because it takes a porous structure. Further, use of kneading in type, impregnation of conductive paint and coating film of conductive polymer may be possible other than the surface active agent. The anti-static electricity treatment may be adjusted within a range of specific surface resistance of  $10^4$  to  $10^9$  ohm·square.

[0031] In this invention, multiple number of sheet shape inorganic material 3 are stored in a container 1 in a condition of being mounted on above described trays 4. In this case, it is able to effectively prevent breakage of the sheet shape inorganic material during such as transportation. Further, the container 1 is designed so that top lid 1a and front side of the enclosure 1b open as shown in Figure 2. Further, other cushion material 2 is located in upper space of the topmost tray 4. This cushion material 2 may be made of the porous resin sheet similar to the tray 4.

[0032] This invention is characterized that the sheet shape inorganic material 3 is taken out with each tray 4 from a container 1 and the taken out sheet shape inorganic material 3 is transported to a specific location while suction is applied from backside of the mounting surface 4b, as shown in Figure 2.

[0033] In concrete, suction surface of a suction transporting means 10 is located in front and a little lowers position than the tray 4 which is to be taken out from the container and the tray 4 to be taken out is moved toward front side with a drive roller or piston mechanism to mount the tray 4 on the suction surface of the suction transporting means 10. This suction surface is composed with such as a porous plate and able to suck down the sheet shape inorganic material 3 through the tray 4.

[0034] Thus it transports the sheet shape inorganic material 3 to a specific location while sucking it from the backside of the mounting surface 4b of the tray 4 with a suction transporting means 10. The transporting mechanism may be any such as a robot hand or various conveyors.

[0035] It is normally transported to a position

of following process or adjacent to it with the means of suction transporting means 10. The sheet shape inorganic material 3 being transported to the adjacent of following process may be moved to a position where the next process is conducted with such as another means of suction, however in this invention, it may be set in a position of following process by turning it over as is to move to the position of following process or adjacent to it then releasing the suction (or pressurizing) because the sheet shape inorganic material 3 is sucked by the suction transporting means 10 during the transportation. Transportation from the positions of taking out from the container 1 to the position of following process may be easily done with this.

#### [Brief explanation of the drawings]

[Figure 1] An illustration showing an example of storage condition of sheet shape inorganic material in this invention.

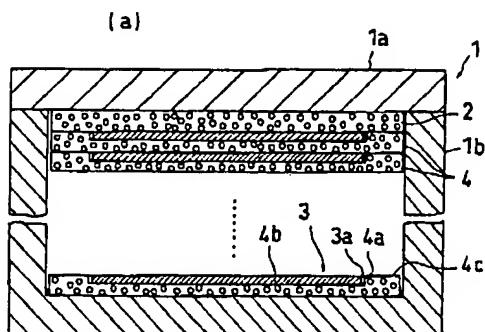
[Figure 2] An illustration showing an example of means of taking out and transportation of sheet shape inorganic material in this invention.

#### [Explanation of numbers]

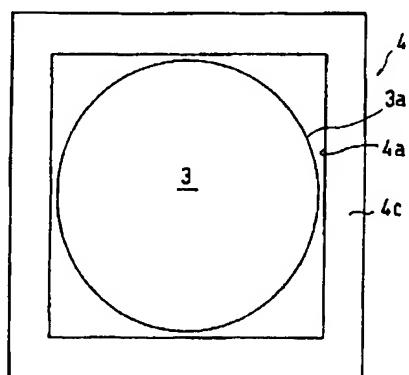
- 1: container
- 3: inorganic sheet shape material
- 3a: side wall
- 4a: holding wall
- 4b: mounting surface
- 10: suction transportation means

Translated by Hideyo Sugimura, 651-490-0233,  
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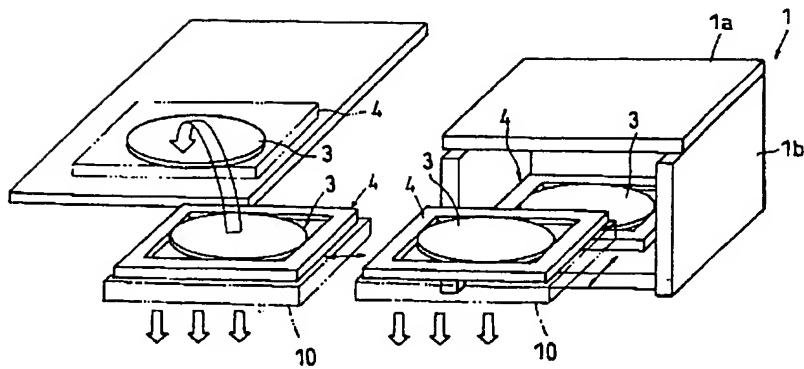
[Figure 1]



(b)



[Figure 2]



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